

Image Forming Apparatus For Permitting Image
Formation in Accordance with Image Attribute,
and Control Method Therefor

5 BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image forming
apparatus, control method therefor, and storage medium
and, more particularly, to an image forming apparatus
10 for permitting image formation in accordance with image
attributes and the like, a control method therefor, and
a storage medium.

Related Background Art

As computer networks are becoming popular,
15 high-quality image information can be obtained via the
networks. This poses social problems such as
protection of the copyright on image information.

To solve such problem, a transmitting source
transmits image information including charging
20 information to a user, or a user sends back charging
information to the transmitting source in accordance
with the use frequency of image information. Image
information including charging information can only be
printed by dedicated software or printer, and is
25 protected from being illegally copied. That is, the
user can print only a predetermined number of images
permitted in accordance with a charge, and is inhibited

from printing more than the predetermined number of images from the original data.

When only a predetermined number of images can be printed, as described above, an image forming apparatus must reliably output them. Particularly for a color image, the image forming apparatus must output the highest quality image regarding the image quality such as the density and tint.

Generally, to maintain high image quality, internal states such as the remaining amount of developing agent and the remaining life of an exchangeable component that may influence images must be guaranteed satisfactorily normal. In normal use, however, these strict requirements degrade the usability. For example, even if the remaining toner is little, images can be printed with quality to a certain degree (so as to discriminate the images). In general, this state is called a warning state in which control for limiting print action is not performed. In this case, the image quality maintenance conditions are always checked. If any condition is satisfied during continuous print, print action stops.

In this manner, when only a limited number of images can be printed, and print action stops during the operation owing to functional deterioration in internal states which may influence images, the user usability greatly degrades.

SUMMARY OF THE INVENTION

It is an object of the present invention to change a criterion used for permission determination of image formation in accordance with the attributes of an image to be formed.

For example, in a print mode required to reliably print an image with high quality, the print is inhibited even when a warning message is displayed but print action continues in a normal print mode. This can suppress degradation in usability even in normal printer use, while coping with a print mode in which print is charged every page.

It is another object of the present invention to perform permission determination of image formation and display corresponding to the attributes of an image to be formed and the apparatus state.

The above and other objects of the present invention will be apparent from the following description in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the schematic arrangement of an image forming apparatus according to the present invention;

Fig. 2 which is comprised of Figs. 2A and 2B are flow charts showing the operation of the image forming

apparatus in the first embodiment; and

Fig. 3 which is comprised of Figs. 3A and 3B are flow charts showing the operation of an image forming apparatus in the second embodiment.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Several preferred embodiments of the present invention will be described in detail below with reference to the accompanying drawings.

10 (First Embodiment)

Fig. 1 is a block diagram showing the schematic arrangement of a color laser printer according to the first embodiment.

15 In Fig. 1, a color laser printer 1 is connected to a host computer 2. The color laser printer 1 comprises a controller 4 and printer engine 5. The printer engine 5 comprises a CPU 6, image data control system 7, remaining toner sensor 8, photosensitive drum memory 9, FD (Face-Down) full load sensor 10, density sensor 11, drive system 12, scanner unit 13, and remaining
20 sheet sensor 14. The image data control system 7, remaining toner sensor 8, photosensitive drum memory 9, FD full load sensor 10, density sensor 11, and remaining sheet sensor 14 are sensing means for sensing
25 internal states which may influence images.

Note that the color laser printer 1 and host computer 2 may be connected through a SCSI cable or

RS-232C cable or through a network.

The operation of the color laser printer 1 will be explained.

The host computer 2 instructs the color laser
5 printer 1 to print data including image data in order
to print an image. The controller 4 is an interface
between the host computer 2 and printer engine 5. The
controller 4 maps image information from the host
10 computer 2 into video data capable of forming an image,
sends the video data to the image data control system
7, and instructs the CPU 6 to execute various control
operations for image formation. The CPU 6 forms an
image by controlling the drive system 12 and image data
15 control system 7 in accordance with the instruction
from the controller 4. The CPU 6 checks the state of
the printer engine 5 from information from various
sensors, and informs the controller 4 of the checked
state.

The self-test operations of respective internal
20 states based on sensing results by the respective
sensing means will be described.

[Remaining Toner]

The first embodiment adopts an optical means for
sensing the remaining toner. The remaining toner is
25 determined by the transmission quantity and time of
light transmitted through the toner vessel. The
remaining toner sensor 8 includes this mechanism, and

sends back remaining toner information to the CPU 6.
From this information, the CPU 6 can determine the
degree of influence of the remaining toner on the image
quality.

5 The remaining toner determination sequence and
mechanical mechanism can be realized by known
techniques, and a detailed description thereof will be
omitted.

[Service Life of Photosensitive Drum]

10 In the first embodiment, a nonvolatile memory such
as an EEPROM as the photosensitive drum memory 9 is
mounted in a photosensitive drum unit in order to check
the service life of the photosensitive drum, and holds
the use history. The photosensitive drum memory 9 is
15 accessed by the CPU 6, and the storage contents are
updated in accordance with the use time of the
photosensitive drum.

 The CPU 6 checks the service life of the
photosensitive drum on the basis of the contents of the
20 photosensitive drum memory 9, and determines the degree
of influence on the image quality.

 The means for mounting the photosensitive drum
memory 9, and the use history update means for
calculating the service life of the photosensitive drum
25 can be realized by known techniques, and a detailed
description thereof will be omitted.

[FD Full Load Sensing]

The color laser printer 1 in the first embodiment is equipped with a face-down delivery tray, and comprises a face-down full load sensing means. If a predetermined number of sheets or more are stacked on the face-down delivery tray, sheets readily jam. To prevent this, the FD full load sensor 10 checks the full load of the tray.

The face-down full load sensing means can be realized by known techniques, and a detailed description thereof will be omitted.

[Density Control]

In density control of the first embodiment, a solid image of an area corresponding to the reflection density which can be sensed by the density sensor 11 is formed by the same process as image formation, and the reflection density is sensed by the density sensor 11. The density sensed by the density sensor 11 is fed back to image formation process conditions by the CPU 6.

When the CPU 6 cannot entirely feed back the density to image formation process conditions from the sensed value of the density sensor 11, the CPU 6 displays a warning message that high-quality image formation cannot be guaranteed. Also when the sensed value of the density sensor 11 represents an abnormal density, the CPU 6 displays a warning message that high-quality image formation cannot be guaranteed, as density sensor abnormality sensing.

The density control means can be realized by known techniques, and a detailed description thereof will be omitted.

[Remaining Sheet Sensing]

5 The color laser printer in the first embodiment comprises a means for sensing remaining sheets at each feed port. The remaining sheet sensing means can sense the presence/absence of sheets at the feed port, and when sheets are present, the number of remaining
10 sheets.

The remaining sheet sensing means can be realized by known techniques, and a detailed description thereof will be omitted.

15 A control instruction (print mode) by the host computer 2 will be explained.

 In instructing the color laser printer 1 to print information, the host computer 2 adds, to print instruction information, information about whether the print requests normal print or reliable high-quality
20 print. For example, to print image information to be charged that is obtained through the network, the information must be reliably printed with high quality. In this case, the host computer 2 transmits information requesting high-quality print together with a print
25 instruction to the color laser printer 1. The CPU 6 of the color laser printer 1 obtains through the controller 4 the information requesting high-quality

print together with the print instruction. If reliable high-quality print is requested (high quality request is instructed), the CPU 6 inhibits print action even in a situation in which a warning message is displayed but
5 print action continues in normal print.

As internal states in such situation, the first embodiment will exemplify little remaining toner, the end of life of the photosensitive drum, FD full load, density sensor abnormality sensing, and image quality
10 out of guarantee under density control.

An internal state control method will be described with reference to a flow chart.

Figs. 2A and 2B are flow charts showing the control of the printer engine 5 of the color laser
15 printer 1 in the first embodiment. Note that each step surrounded by a rectangular frame in Figs. 2A and 2B represents a function of the CPU 6. In the color laser printer 1, the controller 4 and engine 5 operate parallel. The printer engine 5 starts print control in
20 accordance with a print instruction from the controller 4.

A high quality request shown in Figs. 2A and 2B is set or canceled by the controller 4 asynchronously from the flow chart in Figs. 2A and 2B.

25 In Fig. 2A, if the color laser printer 1 is powered on (step 100; each step will be simply referred to as 100 or the like), the CPU 6 initializes the drive

system and image data control system (101).

The CPU 6 performs density control (102), and determines process conditions for stabilizing the image quality. At this time, the CPU 6 detects a density
5 abnormality from the density sensor used in density control, and an abnormality which inhibits the image quality from being stabilized by process conditions.

After density control, the CPU 6 waits for a print instruction from the controller 4. When the host
10 computer 2 instructs print and transmits an image to be printed, the controller 4 instructs the CPU 6 to print the image. Before print, the CPU 6 checks printable conditions.

The CPU 6 first checks the absence of sheets
15 (103). If YES in 103, the CPU 6 does not print the image, displays an error message of no sheet (126), and waits until the tray is replenished with sheets.

If NO in 103, the CPU 6 checks whether the remaining toner is little (checks whether the remaining
20 toner is at least at the first level enough to form a high-quality image) (104). If the remaining toner is sufficient at the first level or higher, the CPU 6 advances to 108. If the remaining toner is
insufficient for forming a high-quality image at less
25 than the first level, the CPU 6 checks whether a high quality request is instructed (105). If NO in 105, no high-quality image can be formed, but the color laser

printer 1 can be normally used without any problem.
Thus, the CPU 6 displays a warning message (107), and
shifts to 108. Note that when the remaining toner is
at less than a level at which even normal use fails,
5 the CPU 6 displays an error message so as not to print
the image. When the remaining toner is at less than
the first level, and a high quality request is
instructed, the CPU 6 displays an error message that
image formation is impossible (106), and returns to 103
10 to wait until the high quality request is canceled or
the developing unit is replenished with the toner.

The CPU 6 checks whether the photosensitive drum
is at the end of life (108). If the photosensitive
drum is new, the CPU 6 advances to 112. If the
15 photosensitive drum is too old to form a high-quality
image, the CPU 6 checks whether a high quality request
is instructed (109). If NO in 109, no high-quality
image can be formed, but the color laser printer 1 can
be normally used without any problem. Thus, the CPU 6
20 displays a warning message (111), and shifts to 112.
Note that when the photosensitive drum is too old to
normally use, the CPU 6 displays an error message so as
not to print the image. When the photosensitive drum
is too old to print a high-quality image, and a high
25 quality request is instructed, the CPU 6 displays an
error message that image formation is impossible (110),
and returns to 103 to wait until the high quality

request is canceled or the photosensitive drum is replaced with a new one.

The CPU 6 checks whether the face-down tray is full (112). If NO in 112, the CPU 6 shifts to 116. If
5 YES in 112, the CPU 6 checks whether a high quality request is instructed (113). If NO in 113, no high-quality image can be formed owing to a jam, but the color laser printer 1 can be normally used without any problem. Thus, the CPU 6 displays a warning
10 message (115), and shifts to 116.

If YES in 113, the CPU 6 displays an error message that image formation is impossible (114), and returns to 103 to wait until the high quality request is canceled or sheets are removed.

15 The CPU 6 checks whether the density sensor senses an abnormal density (116). If NO in 116, the CPU 6 shifts to 120. If YES in 116, the CPU 6 checks whether a high quality request is instructed (117). If NO in 117, process conditions for stabilizing the image
20 quality may be improper, but the color laser printer 1 can be normally used without any problem. Thus, the CPU 6 displays a warning message (119), and shifts to 120. If YES in 117, the CPU 6 displays an error message that image formation is impossible (118), and
25 returns to 103 to wait until the high quality request is canceled.

The CPU 6 checks whether process conditions for

stabilizing the image quality are properly determined (120). If NO in 120, the CPU 6 advances to 125. If the results of density control represent that print is possible but the image quality cannot be guaranteed
5 (YES in 120), the CPU 6 checks whether a high quality request is instructed (121).

If NO in 121, no high-quality print can be guaranteed, but the color laser printer 1 can be normally used without any problem. Thus, the CPU 6
10 displays a warning message (123), and shifts to 125. If YES in 121, the CPU 6 displays an error message that image formation is impossible (122), and returns to 103 to wait until the high quality request is canceled.

The CPU 6 performs print action in accordance with
15 a print instruction from the controller 4 (125).

According to the first embodiment, when the controller 4 instructs high-quality print, the CPU 6 displays an error message and inhibits print action even in a situation in which a warning message is
20 displayed but print action continues in normal print. This makes it possible to reliably form a high-quality image when high-quality print is instructed.

For example, to reliably output a charged image with high quality, the host computer 2 informs the
25 color laser printer 1 of this, and transmits image data, thereby outputting a high-quality image. In normal print, print can be done without degrading the

usability unless high-quality print is instructed.

In the first embodiment, print quality warning information includes little remaining toner, the end of life of the photosensitive drum, FD full load, density
5 sensor abnormality sensing, and image quality out of guarantee. However, the present invention is not limited to this, and the same effects can be attained even using the ends of life of other expendables influencing the print quality, and image quality
10 control conditions.

As for the method of realizing each sensing means, another method may be used. For example, the first embodiment updates data in the nonvolatile memory in order to check the service life of the photosensitive
15 drum. However, the present invention may check the service life using another means.

In the above description, warning and error messages are displayed at the printer 1.
Alternatively, warning and error messages may be
20 displayed at the printer 1, and at the same time, information about the warning and error messages may be transmitted to the host computer 2 which instructed print, and the warning and error messages may also be displayed at the host computer 2.

25 In the above description, various checks are done to display warning and error messages after the host computer instructs print. Instead, these checks may be

done in advance, and the printer state (e.g., normal
print is possible but high-quality print is impossible,
or both normal print and high-quality print are
possible) may be informed in accordance with an inquiry
5 from the host computer.

(Second Embodiment)

The second embodiment has the same basic
arrangement as that of the first embodiment. The
difference in internal state control method from the
10 first embodiment will be mainly described.

Figs. 3A and 3B are flow charts showing an
internal state control method according to the second
embodiment. Similar to Figs. 2A and 2B, each step
surrounded by a rectangular frame in Figs. 3A and 3B
15 represents a function of a CPU 6.

In Fig. 3A, if a color laser printer 1 is powered
on (200), the CPU 6 initializes the drive system and
image data control system (201).

The CPU 6 performs density control (202), and
20 determines process conditions for stabilizing the image
quality. At this time, the CPU 6 detects a density
abnormality from a density sensor used in density
control, and an abnormality which inhibits the image
quality from being stabilized by process conditions.

25 After density control, the CPU 6 waits for a print
instruction from a controller 4. Before this, the CPU
6 checks printable conditions (203). If the print is

not high-quality one but is impossible owing to the
absence of sheets or expandable abnormality, the CPU 6
displays an error message (210), and loops in 203 until
the print impossible condition is canceled. If YES in
5 203, the CPU 6 shifts to 204. Note that printable
conditions checked in 203 include ones corresponding to
the checks in the first embodiment.

The CPU 6 waits for a print instruction from the
controller 4 (204). If NO in 204, the CPU 6 returns to
10 203; if YES, advances to 205.

The CPU 6 checks whether the print instruction
from the controller 4 includes a high quality request.
If NO in 205, the CPU 6 advances to 209; if YES, to
206. In 206, the CPU 6 checks whether the number of
15 instructed print sheets satisfies corresponding
conditions.

In 206, the CPU 6 checks whether the number of
remaining sheets is equal to or larger than the number
of required print sheets. If YES in 206, the CPU 6
20 displays an error message of insufficient sheets (211),
and returns to 203. If NO in 206, the CPU 6 shifts to
207. In this case, the CPU 6 calculates the number of
remaining sheets corresponding to the number of pages
considering double-sided print.

25 In 207, the CPU 6 checks whether the remaining
toner cannot print the number of required print sheets
with high quality. If YES in 207, the CPU 6 displays

an error message of insufficient toner (212), and returns to 203. If NO in 207, the CPU 6 advances to 208.

5 In 208, the CPU 6 checks from the remaining life of the photosensitive drum whether the number of required print sheets cannot be printed with high quality. If YES in 208, the CPU 6 displays an error message that the number of required print sheets cannot be printed with high quality owing to the remaining
10 life of the photosensitive drum (213), and returns to 203. If NO in 208, the CPU 6 advances to 209.

In 209, the CPU 6 prints the number of required print sheets.

15 According to the second embodiment, the number of high-quality printable pages is checked in advance in consideration of the number of sheets to be printed with high quality. This makes it possible to reliably print a desired number of pages with high quality.

20 In the second embodiment, the number of required print sheets is obtained from the controller 4 to check the number of sheets to be printed by a printer engine 5. Alternatively, the controller 4 may be informed of the state of the printer engine 5 to confirm the number of printable pages by the controller 4. This control
25 may be executed by a host computer 2.

Also in the second embodiment, an error message is displayed at the printer. Instead, similar to the

first embodiment, the host computer may be informed of an error message, and the host computer may display the error message.

(Third Embodiment)

5 The third embodiment has the same basic arrangement and control contents as those of the first or second embodiment. The difference from the first embodiment will be mainly described.

10 In the first and second embodiments, the printer engine 5 (CPU 6) determines whether high-quality print is possible/impossible. In the third embodiment, a controller 4 performs this determination.

15 For this purpose, information for determining whether high-quality print is possible/impossible is transmitted from the printer engine 5 to the controller 4, in place of transmitting a high-quality print request from the controller 4 to the printer engine 5 in the first and second embodiments.

20 The controller 4 determines based on this information whether high-quality print is possible, and controls whether to instruct the printer engine 5 to print information.

25 According to the third embodiment, the controller 4 determines whether high-quality print is possible. This makes it possible to manufacture a printer capable of performing high-quality print even using the printer engine 5 not corresponding to high-quality print.

Note that each embodiment has exemplified the printer, and particularly the color laser printer 1. However, the present invention is not limited to this, and can also be applied to another type of printer such as an ink-jet printer. Further, the present invention is not limited to the printer, and can also be applied to another image forming means such as a display.

The present invention includes program codes themselves for operating various devices and a means for supplying the program codes to a computer so as to realize the functions of the image forming apparatus described in each of the first to third embodiments, and program codes of steps for realizing the image forming method and a means for supplying the program codes to the computer. An example of these means is a storage medium storing the program codes.

In this case, a predetermined reproduction device reads out the program codes stored in the storage medium to operate an EEPROM. As the storage medium for storing the program codes, a floppy disk, hard disk, optical disk, magnetooptical disk, CD-ROM, magnetic tape, nonvolatile memory card, and ROM are available.

The functions of each embodiment are realized not only by executing the supplied program codes supplied by the computer, but also by the program codes in cooperation with an OS (Operating System) or another application software running on the computer. These

program codes are incorporated in the present invention.

5 The functions of each embodiment are also realized when the supplied program codes are stored in the memory of a function expansion board in the computer or a function expansion unit connected to the computer, and the CPU of the function expansion board or function expansion unit performs part or all of actual processing on the basis of the instructions of the
10 program codes. This system is also incorporated in the present invention.

The present invention can change conditions used for permission determination of image formation in accordance with the attributes of an image to be
15 formed. For example, in a print mode required to reliably print an image with high quality, the print is inhibited even when a warning message is displayed but print action continues in a normal print mode. This can suppress degradation in usability even in normal
20 printer use, while meeting a print mode in which print is charged every page.

In addition, the present invention can perform permission determination of image formation and display corresponding to image attributes and apparatus state.